

Shoreline Change Special Area Management Plan (SAMP)

VOLUME 1

Table of Contents

Chapter 1- Introduction	2
1.1 Vision Statement	2
1.2 Statement of the Problem.....	3
1.3 Enabling Legislation and Existing Policy Framework.....	5
1.4 Shoreline Change SAMP Scope and Study Area.....	7
1.5 Goals of the Shoreline Change SAMP	7
1.6 Principles Guiding the Design and Development of the Shoreline Change SAMP	8
1.7 Contents of Shoreline Change SAMP Document	9
1.8 Collaborative Effort	12
References	12

Chapter 1- Introduction

1.1 Vision Statement

1. The coastline of Rhode Island is one the state's most iconic and treasured assets. The 417 miles of barrier beaches, historic waterfronts, bluffs, headlands and salt marsh make Rhode Island the 'Ocean State' and give rise to major sectors in the state's economy including tourism and marine trades.
2. Rhode Island has long been a leader in innovative thinking and the successful management of its most prized coastal features and resources. While coastal resilience has now become a modern day buzz word following major storm events such as Hurricane Katrina in 2005 and Hurricane Sandy in 2012, resilience has long been a part of the fabric and tradition of Rhode Island. One only has to look back to Rhode Island's history in colonial times to see examples of innovation in policy and technology, or to the recovery from the Great Hurricane of 1938 to see the resilience of Rhode Islanders and the coastal communities and ecosystems that make up the state.
3. Changing global climate means a new normal for Rhode Island. The water's edge is shifting as coastal storms intensify, wave action carries away sand, and high tide rises. These rapidly changing environmental conditions are challenging Rhode Island's coastal communities and ecosystems which are struggling to adapt. What has not changed is Rhode Island's spirit of resilience and innovation in the face of challenging issues.
4. It is the Rhode Island Coastal Resources Management Council's responsibility to ensure that decisions made concerning Rhode Island's coastline are well thought out and based on the best available science. **Toward that end, the vision of the Rhode Island Shoreline Change Special Area Management Plan (SAMP) is to provide guidance and tools for state and local decision makers to prepare and plan for, absorb, recover from, and successfully adapt to the impacts of coastal storms, erosion, and sea level rise.**
5. Because planning for sea level rise, storms and erosion is so closely tied to land use decision making at the local level, the research, tools and strategies presented in the Shoreline Change SAMP were developed with coastal municipalities and state agencies in mind. The Shoreline Change SAMP has been designed purposefully to be a guidance and planning document rather than a more prescriptive regulatory document with explicit policies, regulations or standards, in order to provide the flexibility to local and state decision makers on the frontline in protecting the health and welfare of their residents, to identify strategies most appropriate for a specific community.
6. The intended audience for this SAMP, in addition to CRMC members and staff, are decision makers, planners, boards and commissions in Rhode Island's 21 coastal

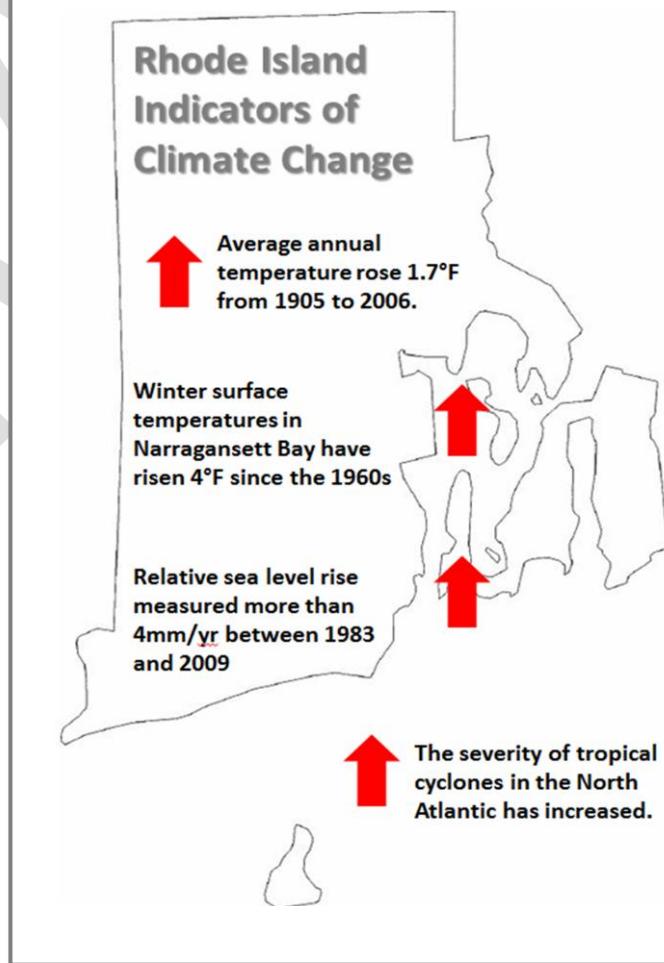
communities who are principally responsible for coping with the impacts of storms, coastal erosion, and sea level rise. The Shoreline Change SAMP is also intended to aid other state and federal agencies responsible for coastal resources, assets and property in Rhode Island in future planning and decision making.

1.2 Statement of the Problem

1. Rhode Island's coastline is continuously shaped by storms, tidal inundation and erosion. As the climate changes, the impacts of these natural coastal processes and hazards are increasingly threatening coastal properties, infrastructure, and social, cultural and environmental assets throughout the state.
2. Dynamic storm events can highlight the damaging impacts of storm surge and flooding on coastal communities, the migratory nature of the coastal barriers along Rhode Island's southern coast, and the importance of preparedness and planning at both the state and local level to expedite recovery. For example, Superstorm Sandy, a hybrid tropical/extratropical storm that made landfall in October 2012, affected the Rhode Island coastline with several days of storm surge and

Box 1 Climate Change & Rhode Island

Human activities since the start of the Industrial Age, around the 1750s, have caused a significant increase in greenhouse gases (primarily carbon dioxide) in the atmosphere causing a rise from a level of 280 parts per million (ppm) in pre-industrial times to over 400 ppm in 2015 (NOAA Earth System Research Laboratory, 2015), the highest it has been in 800,000 years (Heffner et al. 2012; IPCC 2014; Allison et al. 2009). There is strong scientific consensus that carbon dioxide in the atmosphere warms the air and sea surface, accelerates sea level rise, makes the ocean more acidic, causes shifts in precipitation and weather patterns, and leads to more extreme weather events, among other effects (Anderegg et al. 2010; Gleik et al. 2010). These effects are already being witnessed globally and in Rhode Island and are projected to intensify in years to come.



waves but very little rainfall. National Ocean Service tide gauges reported storm surges of 5.3ft and 6.2ft in Newport and Providence respectively, with maximum sustained winds of 64 mph (56kts) and gusts from 81-86mph (70-75kts) (National Hurricane Center, 2013). The damage caused was felt heavily across the southern coast of the state from Narragansett to Westerly. Ultimately, this storm affected approximately 300,000 Rhode Island residents (28% of the state's population); resulted in over \$12.6 million in requested public assistance from the Federal Emergency Management Agency; and \$24 million in claims to the National Flood Insurance Program just for damage in Washington County (RI Office of Housing and Community Development, 2013). However, despite the damage caused, this storm wasn't a hurricane or even a once in one hundred year (1% annual chance) storm event when it made landfall in Rhode Island, rather it was a once in 25-year storm (4% annual chance) event for Westerly, and a much less intense storm event for the rest of the state. Had this storm been a hurricane or a 1% annual chance storm event, impacts would have much greater.

3. Tide gauge observations in Newport indicate a rate of 10.8 inches (27.4 cm) of relative sea level rise over the last century or 2.74 mm per year¹. However, the rate of sea level rise globally and in Rhode Island specifically is accelerating. The CU Sea Level Research Group reports current satellite altimetry measurements of the rate of global sea level rise of 3.3 +/- 0.4 mm per year since 1993. Relative sea level rise in Rhode Island measured more than 4 millimeters per year between 1983 and 2009 (Carey et al. 2015). The highest NOAA projections for Newport, Rhode Island suggest that by 2100 sea levels may rise as much as 7 feet above 1990 levels.² As of 2015, NOAA projects the range in sea level rise above 1990 levels to be a maximum of approximately 1 foot by 2035, 2 feet by 2050, and 7 feet by 2100.³ Looking forward, as sea level rises both hurricanes and "nor'easters" will be more damaging, and the flooding effects will be felt farther inland. Storm surge and wave heights will increase as sea level rises resulting in more properties being damaged or destroyed during a storm, including inland properties that have never before experienced flood damage. Furthermore, not only will the extent of flooding expand and storm surge levels rise during storm events like Superstorm Sandy, but more areas will be affected by high tides on a daily basis. Frequent tidal inundation of coastal properties, roadways and parking lots is already an issue in many coastal communities in Rhode Island from Watch Hill, to Wickford, to Warren and Providence.
4. The state's coastal wetlands are highly vulnerable to accelerating sea level rise; essentially they are drowning in place. Permanent flooding of Rhode Island's wetlands is already occurring, as these wetlands cannot gain sufficient elevation to keep up with sea level rise. This trend will continue into the future causing significant loss of habitat for

¹ NOAA Tide Gauge Data for Newport, RI:

http://tidesandcurrents.noaa.gov/slrends/slrends_station.shtml?stnid=8452660

² U.S. Army Corps of Engineers and NOAA Sea Level Rise Curves <http://www.corpsclimate.us/ccaceslcurves.cfm>

³ These planning horizons are have been proposed to be included in CRMC's Climate Change and Sea Level Rise Policy (Section 145 of the Coastal Resources Management Program (a.k.a. Red Book).

fish, shellfish, birds, and other wildlife, and recreation areas. The loss of coastal wetlands also means a loss of the protection they provide to coastal communities as an important natural barrier to storm surge. In addition, the loss of coastal wetland will reduce the overall carbon storage potential of these ecosystems and result in an increased contribution of CO₂ concentrations to the atmosphere. A recent statewide analysis of sea level rise impacts to salt marshes conducted by CRMC and partners estimates a 52% and 87% loss in existing salt marsh with three and five feet of sea level rise, respectively. Therefore it is imperative that state and local planning and adaptation efforts start now (see Technical Report #1 in Volume 2 for more information).

1.3 Enabling Legislation and Existing Policy Framework

1. The federal U.S. Coastal Zone Management Act⁴ outlines the role of state coastal zone management programs in planning for both existing and future coastal hazards, specifically sea level rise. The Act states:

“Because global warming may result in a substantial sea level rise with serious adverse effects in the coastal zone, coastal states must anticipate and plan for such an occurrence.” (16 U.S.C. § 1451(l))

Congress also directed that coastal zone management programs manage coastal development:

“to minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence, and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands...” (16 U.S.C. § 1452(B))

2. Rhode Island State Law also echoes the role of Rhode Island Coastal Resources Management Council (CRMC) to conduct long-term planning through the agencies enabling legislation:

“it shall be the policy of this state to preserve, protect, develop, and, where possible, restore the coastal resources of the state for this and succeeding generations through comprehensive and coordinated long range planning and management designed to produce the maximum benefit for society from these coastal resources...” (R.I.G.L. § 46-23-1)

Furthermore, in 2006, the Rhode Island General Assembly explicitly authorized CRMC to:

⁴ 16 U.S. Code Chapter 33

*"develop and adopt policies and regulations necessary to manage the coastal resources of the state and protect life and property from **coastal hazards resulting from projected sea level rise and probable increased frequency and intensity of coastal storms due to climate change.**" (R.I.G.L. § 46-23-6)*

In 2008, CRMC adopted Section 145 Climate Change and Sea Level Rise into the Rhode Island Coastal Resources Management Program (RICRMP, also known as the Red Book), making Rhode Island one of the first states in the nation to adopt a policy on sea level rise. The policy includes the current science and facts about climate change and sea level rise impacts in the state, and established criteria for future policies, plans, and regulations to proactively address and adapt to climate change and sea level rise.

3. The Resilient Rhode Island Act of 2014 (R.I.G.L. § 42-6.2) recognized the threat that climate change presents to the State of Rhode Island, its communities, businesses and residents. As a result, it established the Executive Climate Change Coordinating Council (EC4) and charged this group with leading and coordinating state agencies in responding to these challenges in a timely and effective manner, focusing in particular on:
 - Advancing the state's understanding of the effects of climate change including, sea level rise, coastal and shoreline changes, severe weather events, critical infrastructure vulnerability, and ecosystem, economic, and health impacts;
 - Identify strategies to prepare for these effects and communicate them to Rhode Islanders;
 - Work with municipalities to support the development of sustainable and resilient communities;
 - Identify and leverage federal, state, and private funding opportunities for emission reduction and climate change preparedness and adaptation work in Rhode Island;
 - Advise the governor, the general assembly, and the public on ways to ensure that Rhode Island continues to be a national leader in developing and implementing strategies that effectively address the challenges of climate change;
 - Work with other New England states to explore areas of mutual interest to achieve common goals; and
 - Identify and facilitate opportunities to educate the public about climate change and efforts throughout state agencies and municipalities to address climate change.

The EC4 membership includes the state directors of Administration, Coastal Resources Management, Commerce, Emergency Management, Energy Resources, Environmental Management, Health, Planning and Transportation.

4. Recognizing the need for comprehensive planning to address the impacts of storm surge, flooding, sea level rise and erosion, the CRMC initiated the development of the

Rhode Island Shoreline Change Special Area Management Plan (SAMP). SAMPs have been a valuable management tool for CRMC to tackle challenging coastal issues such as water quality, coastal development patterns, and siting offshore renewable energy. The Shoreline Change SAMP builds off previous work completed through the Salt Ponds SAMP and the Metro Bay SAMP, where the impacts of development and coastal hazards were examined.

1.4 Shoreline Change SAMP Scope and Study Area

1. This SAMP is focused on the coastal effects of rising sea levels and the increased frequency and severity of coastal storm events. Other climate change impacts caused by increased precipitation, riverine flooding, heat, etc. are not addressed in this document.
2. The study area for this SAMP encompasses the entire coastal zone of Rhode Island and all 21 coastal communities impacted by sea level rise, storm surge and tidal flooding, as well as coastal erosion.

1.5 Goals of the Shoreline Change SAMP

1. **The Rhode Island Shoreline Change SAMP provides state and local decision makers with information, guidance and a suite of tools to assess, plan for, recover from and adapt to the impacts of coastal storms and sea level rise.** To accomplish this goal, new data and information will be collected and modeled to illustrate areas, resources and infrastructure that may be impacted under different storm and sea level rise scenarios. Planning tools, adaptation strategies and best practices relevant to Rhode Island will be compiled and shared to inform state and local decision making. Tailored technical assistance will be provided to the maximum extent possible to local and state officials to assist in the implementation and use of the information, guidance and tools developed through this SAMP.
2. **Provide a forum for public discourse on current and future impacts and how best to adapt to the short and long-term impacts of coastal storm events and rising tide levels.** The Rhode Island Shoreline Change SAMP stakeholder process will be designed so that information can be shared on how sea level rise, storm events and coastal erosion will impact the people, places and resources in Rhode Island. In addition, this public forum will provide an avenue for two-way exchange of ideas and concerns regarding adaptation, planning and response to these impacts at both the state and local level.
3. **The Rhode Island Shoreline Change SAMP informs revisions to the policies and standards in the Rhode Island Coastal Resources Management Program and existing**

CRMC SAMPs to better address the risks posed by erosion, coastal storms and sea level rise. The Shoreline Change SAMP research, tools and stakeholder process will provide the scientific evidence, background information, and best practices to support updates to Rhode Island's coastal policies aimed at increasing coastal resilience throughout the State.

4. **Minimize the impacts of coastal hazards through proactive planning.** Following the federal mandate set forth in the Coastal Zone Management Act, the development of the Shoreline Change SAMP will aim to provide guidance on how to minimize the impacts and consequences caused by improper development in areas at risk to coastal hazards including erosion, storm surge and sea level rise. Guidance will be focused on reducing damage and supporting wise investments in sustainable coastal development
5. **Maximize the protection of public access, recreation and sensitive coastal resources.** Guidance developed through the Shoreline Change SAMP will consider how public access, recreation and sensitive coastal resources will be impacted by coastal hazards and how planning, development standards, adaptation strategies, or policies can protect or minimize negative impacts.

1.6 Principles Guiding the Design and Development of the Shoreline Change SAMP

1. Guiding the development of the Shoreline Change SAMP are four core principles aimed at ensuring the plan is developed through an open, public process, using the best information that is reviewed and updated regularly to reflect current understanding of the issues. Descriptions of the four guiding principles are provided below:
 - **Develop Shoreline Change SAMP in a transparent manner.** Transparency guides the development of all components of the Shoreline Change SAMP, including SAMP chapters, and related RICRMP policies, regulations and standards. Findings of the Shoreline Change SAMP will be regularly communicated to stakeholders and the general public in an understandable and timely manner.
 - **Maximize agency coordination and public participation.** Interagency coordination on issues related to planning for coastal hazards will be conducted throughout the Shoreline Change SAMP. Targeted efforts ensure opportunity is available for all stakeholders to have access to the Shoreline Change SAMP planning process as early as possible. Stakeholder participation ensures that a broad range of issues, concerns, and creative ideas, are heard and examined throughout the SAMP process.
 - **Base all decisions on the best available science.** All management and regulatory decisions will be based on the best available science. Where possible, new research will be supported to better inform the Shoreline Change SAMP. As new

information becomes available, the Shoreline Change SAMP will be updated to best reflect the current state of knowledge.

- **Establish monitoring and evaluation that supports adaptive management.** Incorporating monitoring and evaluation in the Shoreline Change SAMP will contribute towards implementing a systematic process for continually improving management policies and practices in an environment exposed to constant change. The SAMP process is flexible enough to react to such changes and allow plans to be revised in due course. As new information and lessons learned are gathered, the Shoreline Change SAMP will be updated and revised, along with corresponding CRMC policies, regulations and standards. A strong stakeholder process, coordination among federal and state regulatory agencies, as well as local municipalities, and a transparent, monitoring and evaluation mechanism ensures this activity.
2. As mentioned above, the Shoreline Change SAMP is meant to be a living document that will be updated frequently with new information and findings as they become available. While many CRMC SAMPs have been updated periodically, because the issues and impacts of shoreline change, storms and sea level rise is such an active research area, it is anticipated that the Shoreline Change SAMP will be the most adaptive SAMP, being revised regularly. All revisions and updates will undergo a public review and input process and follow the same guiding principles listed above.

1.7 Contents of Shoreline Change SAMP Document

1. The Shoreline Change SAMP is comprised of two volumes. Volume 1 provides: a synthesis of the current scientific understanding of sea level rise, storm surge, tidal flooding, and coastal erosion, as well as the impacts these hazards pose to infrastructure, other developed property such as municipal buildings and residential properties, and the social, environmental and cultural assets in Rhode Island; a description of the tools developed to model and map potential future impacts from these coastal hazards; a discussion of risk and risk management within the coastal zone; and recommendations for best management practices and adaptation strategies or techniques to be employed at both the state and local level to minimize future risk. Volume 2 contains all the technical reports that support the new research conducted as part of the SAMP project. These technical reports contain more detailed information on research methodology and findings and ultimately support the synthesis provided in Volume 1.

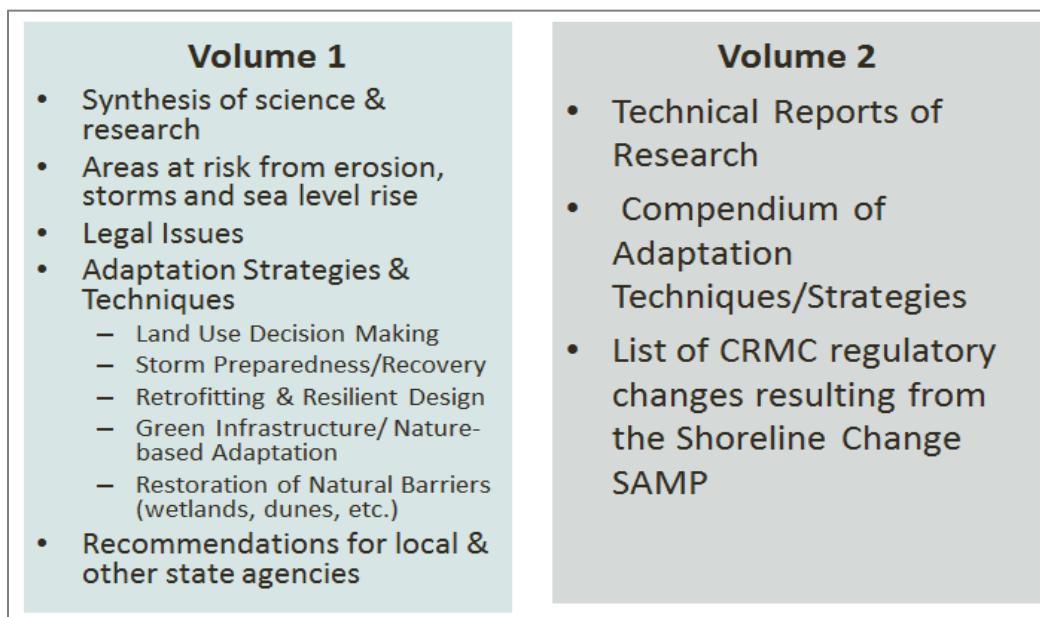


Figure 1. Summary of the contents of Volume 1 and 2 of the Rhode Island Shoreline Change Special Area Management Plan.

2. Volume 1 of the Shoreline Change SAMP contains five chapters:

- ***Chapter 1- Introduction:*** This chapter outlines the purpose and structure of Shoreline Change SAMP.
- ***Chapter 2- Trends and Status: Current and Future Impacts of Coastal Hazards:*** This chapter summarizes the best available science on coastal erosion, storm and sea level rise trends in Rhode Island. Mapping and modeling tools developed as part of the Shoreline Change SAMP to aid state and local planning and decision making are also described.
- ***Chapter 3 Coastal Hazard Impacts on Rhode Island Coastal Resources & Development*** - This chapter summarizes how current and future coastal hazards may impact infrastructure, property, and the social, environmental and cultural assets in Rhode Island.
- ***Chapter 4 Assessing Coastal Risk:*** The purpose of this chapter is to define coastal risk, resilience & related terms; discuss the principles of coastal risk management and the types of measures that can be used to reduce risk; describe the implications to not considering coastal risk and resilience into state and local planning including legal liability issues and economic consequences.
- ***Chapter 5- Guidance for Planning & Addressing Coastal Hazard Locally:*** The purpose of this chapter is to provide municipal guidance on how to incorporate coastal hazards into their local planning and decision making.
- ***Chapter 6- Guidance for Planning & Addressing Coastal Hazards in Coastal Development Permitting.*** This chapter contains a series of guiding steps on how

coastal development permitting decisions can consider the impacts of current and future coastal hazards.

- **Chapter 7- Adaptation Strategies & Techniques:** The focus of this chapter is on presenting an array of best management practices to improve state and local planning and decision making with respect to shoreline change and coastal hazards. In addition, physical adaptation techniques, retrofits and structural design considerations are also discussed.
- **Chapter 8- Conclusion:** This final chapter summarizes the major points presented in Volume 1 of the Shoreline Change SAMP, how this SAMP will be continuously updated with new information as it becomes available, and the future steps to be taken by CRMC to address the impacts of sea level rise, storm surge and flooding, and coastal erosion.

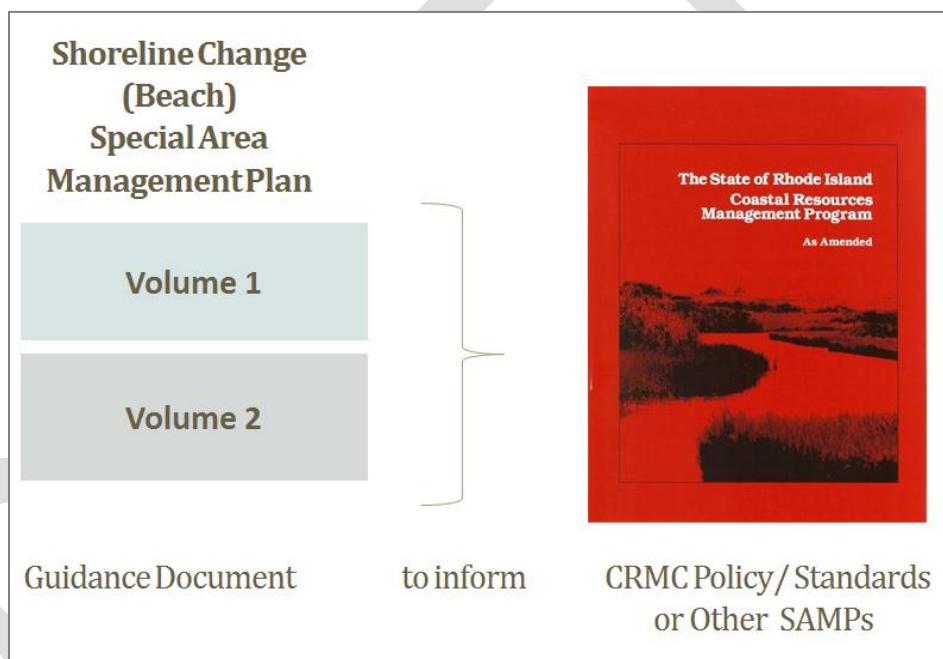


Figure 2. The Shoreline Change SAMP will be a guidance document that is used to inform regulatory changes to the Rhode Island Coastal Resources Management Program.

3. All new or revised CRMC policies and standards concerning sea level rise, storm events and erosion developed through the Shoreline Change SAMP process will be made directly to the RICRMP (also referred to as the Red Book) or existing SAMP policies and standards (see Figure 2). As a result there will not be a section or chapter within Volume 1 of the Shoreline Change SAMP that lists new policies.

1.8 Collaborative Effort

1. The Shoreline Change SAMP is a collaborative effort between the state's coastal agency, the CRMC, and a University of Rhode Island (URI) team comprised of both researchers from the College of the Environment and Life Sciences [CELS], the Graduate School of Oceanography, the College of Engineering, and outreach experts from the Coastal Resources Center/Rhode Island Sea Grant College Program [CRC/Sea Grant]. Invaluable expertise is also provided by Roger Williams Law School's Marine Affairs Institute, the Rhode Island Sea Grant Legal Program, and Eastern Connecticut State University. Close collaboration with other state agencies and coastal municipalities is also a key component of the Shoreline Change SAMP. This collaboration ensures that cutting-edge science informs an inclusive policy development process focused on practical solutions and outcomes.

References

- Allison, I., Bindoff, N.L., Bindschadler, R.A., Cox, P.M., de Noblet, N., England, M.H., Francis, J.E., Gruber, N., Haywood, A.M., Karoly, D.J., Kaser, G., Le Quéré, C., Lenton, T.M., Mann, M.E., McNeil, B.I., Pitman, A.J., Rahmstorf, S., Rignot, E. Schellnhuber, H.J., Schneider, S.H., Sherwood, S.C., Somerville, R.C.J., Steffen, K., Steig, E.J., Visbeck, M. and A.J. Weaver. 2009. The Copenhagen Diagnosis: Updating the World on the Latest Climate Science. The University of New South Wales Climate Change Research Centre (CCRC), Sydney, Australia. 60pp.
- Anderegg, W.R.L., Prall, J.W., Harold, J., and Schneider, S.H. 2010. Expert Credibility in Climate Change. Proceedings of the National Academy of Sciences of the United States of America (PNAS) 107: 12107-12109.
- Gleick et al. 2010. Climate change and the integrity of science. Science 328(5979):689- 690.
- Intergovernmental Panel on Climate Change (IPCC). 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.
- National Hurricane Center, 2013. Tropical Cyclone Report Hurricane Sandy (AL182012) 22 – 29 October 2012. Available online at: http://www.nhc.noaa.gov/data/tcr/AL182012_Sandy.pdf.
- NOAA [National Oceanic and Atmospheric Administration] Earth System Research Laboratory, 2015. Trends in Atmospheric Carbon Dioxide. Recent Monthly Average Mauna Loa, Hawaii CO₂ Observations. Available online at: <http://www.esrl.noaa.gov/gmd/ccgg/trends/>

Heffner, L., Williams, R., Lee, V., Rubinoff, P., and Lord, C. 2012. Climate Change & Rhode Island's Coasts: Past, Present, and Future. Coastal Resources Center and Rhode Island Sea Grant, University of Rhode Island, Narragansett, R.I. Available online at:
http://seagrant.gso.uri.edu/wp-content/uploads/2014/05/climate_summary.pdf

USACE 2014. Reducing Coastal Risk on the East and Gulf Coasts. Committee on U.S. Army Corps of Engineers Water Resources Science, Engineering, and Planning: Coastal Risk Reduction Water Science and Technology Board

DRAFT